STEM Workforce Data Project: Report No. 6

Four Decades of STEM Degrees, 1966-2004: "The Devil is in the Details"

ABSTRACT

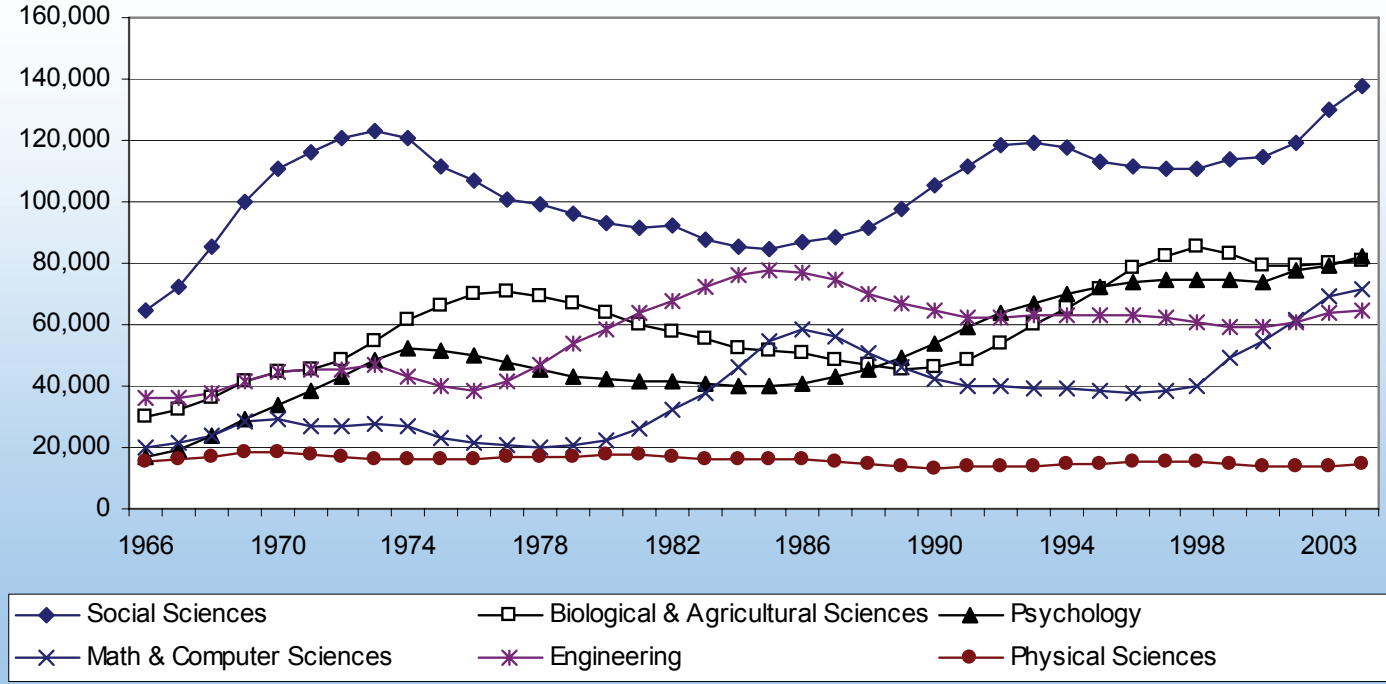
The total number of U.S. degrees awarded in STEM fields — science, technology, engineering, and mathematics — increased 258 percent in the last four decades, from 239,333 in 1966 to 616,463 in 2004. This was somewhat slower than the rate seen for all degrees combined, which rose 294 percent from 682,729 in 1966 to 2,004,701 in 2004. At the bachelor's level, the number of STEM degrees, including engineering technologies and science technologies, rose nearly 252 percent during that time interval — from 186,670 to 470,308. Despite their growth, STEM degrees still represented only about a third of all U.S. bachelor's degrees awarded in 2004, the same proportion that they represented in 1966. The number of STEM master's degrees nearly tripled, from 41,093 in 1966 to 119,880 in 2004, but did not keep pace with the growth of master's degrees awarded in other fields, most notably business. The number of STEM doctoral degrees also increased between 1966 and 2004, growing from 11,570 to 26,275, but much of that growth was attributable to temporary residents.

This is the sixth report in a series on recent trends in the scientific and technical professions. All of these materials, including detailed data archives, are available on the World Wide Web at http://www.cpst.org.

OVERVIEW

In an examination of trends in science and technology degrees, many stories emerge. One story that dominates this analysis is the increasing participation of women and under-represented minorities (URMs) — African Americans, American Indians/Alaska Natives, and Hispanics — in higher education, particularly at the bachelor's level. Women's share of STEM bachelor's degrees doubled over nearly 40 years. In 1966, women earned 24.5 percent of the STEM bachelor's degrees; by 2004, they earned 49.2 percent, with varied proportions within individual STEM disciplines. URMs also made gains at the bachelor's level, increasing their share of these degrees among all STEM fields from 9.0 percent in 1977 to 16.5 percent in 2004. Women, and to a lesser extent URMs, have also made inroads at the higher degree levels.

Exhibit 1: STEM Bachelor's Degrees by Broad Field, 1966 to 2004



Source: CPST, derived from National Science Foundation WebCASPAR database. (No data available for 1999.)

Another story that emerges is that the field preferences of students shifted as employment opportunities changed and new fields emerged and matured. In 1966, computer science as a discipline was not even on the radar screen, with only 89 bachelor's degrees awarded, representing a mere 0.05 percent of all STEM bachelor's degrees. By 2004, 57,405 bachelor's degrees were granted in computer sciences, accounting for 12.2 percent of all STEM degrees. In contrast, in 1966, chemistry degrees at the baccalaureate level represented 5.2 percent (9,735 out of 186,670) of all these STEM degrees, but by 2004 they represented only 2.0 percent (9,305 out of 470,308), and would have been even lower without the entry of women. Similar stories are evident for physics and psychology, with physics declining and psychology increasing. Some of these changes may be attributable to increasing inter-disciplinarity between fields such as biology and chemistry, or physics and electrical engineering, as well as the changing composition of the U.S. economy, with the decline of the manufacturing sector and the rising influence of the service sector. For details about the numbers of degrees awarded by level and year, see Appendix Exhibit A1 in this report and the data archives associated with the STEM Workforce Data Project report series at http://www.cpst.org.

A third story is the rising numbers of temporary residents and declining numbers of U.S. citizens and permanent residents earning doctorates in the STEM disciplines. In 1966, U.S. citizens and permanent residents earned 83.5 percent (9,657 out of 11,570) of the doctoral degrees in the STEM disciplines, but in 2004, they earned just 59.8 percent (15,721 out of 26,275). There are vast differences between the disciplines by citizenship status, with temporary residents comprising more than half of the doctorates in engineering, physics and computer science in 2004 but just 5.6 percent of those in psychology.

BACHELOR'S DEGREES

The baccalaureate is the most common degree in the STEM fields,[1] accounting for three out of every four (76.3 percent) STEM degrees awarded in 2004, down slightly from the 78 percent share it represented in 1966. STEM degrees have constituted about one-third of all bachelor's degrees awarded in the U.S. for the past 40 years, ranging from a high of 36.3 percent in 1969 and 1970 to a low of 32.1 percent in 1991. Except for a brief downturn in the late 1980s, the number of STEM bachelor's degrees has risen steadily, from 186,670 in 1966 to 470,308 in 2004. This was a slightly slower rate of growth than that for all bachelor's degrees combined. Overall, from 1966 to 2004, the number of bachelor's degrees awarded in all fields increased by a factor of 2.7 — from 524,008 in 1966 to 1,407,009 in 2004. However, the number of bachelor's degrees awarded in the natural sciences and engineering increased by only a factor of 2.3, growing from 102,983 to 234,911. This slower rate of degree production in the natural sciences and engineering may present future problems for the ability of the U.S. to remain competitive in the global economy.

Looking at bachelor's degree production by discipline, as shown in Exhibit 1 on the first page of this report, reveals changing student interests within the STEM disciplines. One dramatic change has been in the physical sciences, whose share of total STEM degrees has declined by nearly two-thirds. In 1966, 8.3 percent of STEM bachelor's degrees were earned in the physical sciences, a figure that declined to 3.0 percent in 2004. These declines applied to both of the two major sub-disciplines within the physical sciences group: chemistry and physics. Some of this decline may be attributable to the increasing interdisciplinarity of the physical and biological sciences, particularly between biology and chemistry, as well as the changing makeup of the U.S. economy, with the service sector comprising nearly four out of every five jobs and few physical scientists working in this sector. In contrast, in 1966 the number of bachelor's degrees awarded in psychology represented 9.1 percent of all STEM degrees, but by 2004, that share had nearly doubled to 17.5 percent.

The devil in the details: gender differences by discipline

Looking only at the totals graphed in Exhibit 1 masks differences in disciplines' gender makeup, or as has been said many times by many people, "the devil is in the details." Appendix Exhibit A2 shows the percentage of degrees for selected years at each level (bachelor's, master's, doctoral) awarded to women within each of the broad STEM fields.

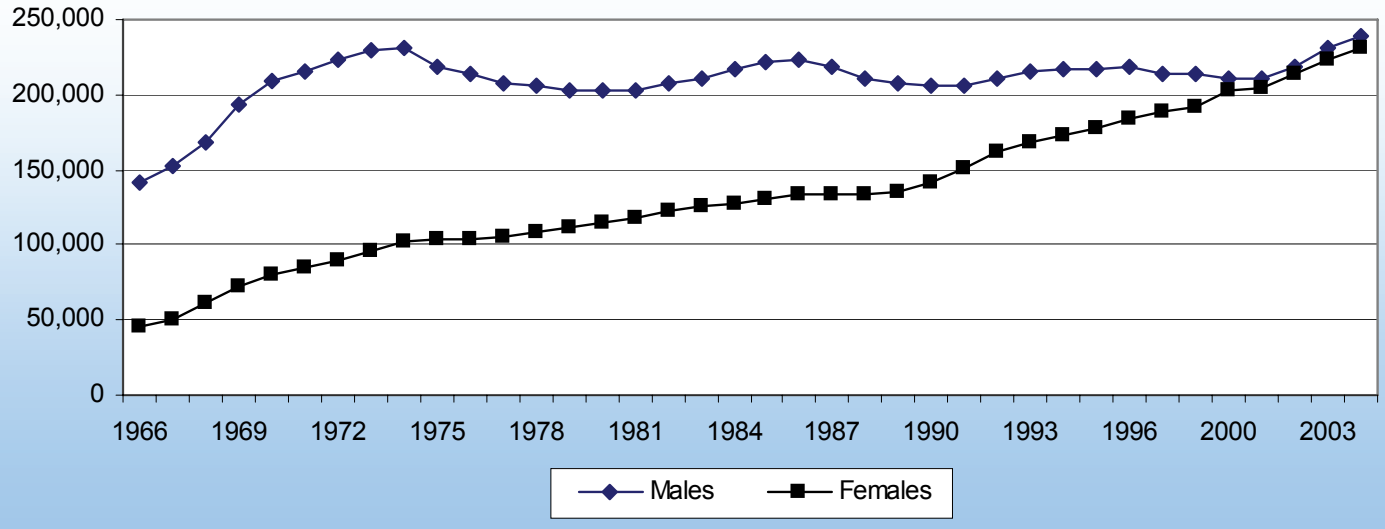
From 1966 to 2004, the number of bachelor's degrees earned in **engineering** peaked in 1985 at 77,572 before leveling off in the 1990s in the low 60,000s.[2] The number of degrees started back up in the early part of the 21st century, reaching 64,675 in 2004. In 1966, women were barely a blip among engineering baccalaureates, earning only 146 out of a total of 35,826 degrees awarded, a mere 0.4 percent. By 2004, they earned one of every five bachelor's degrees in engineering (20.5 percent, representing 13,257 degrees). Over the past six years, however, the number of women earning bachelor's degrees in engineering has stalled at slightly over 20 percent. There was even a drop in absolute numbers from 2000 to 2001. If declines continue in the number of women undergraduates enrolled in engineering, further drops in engineering degree production may loom ahead.

The number of bachelor's degrees granted in **biological and agricultural sciences** steadily increased from 29,804 in 1966 to 70,589 in 1977 and then started to decline reaching 45,531 in 1989. However, degree awards in

[1] STEM fields include the biological and agricultural sciences; physical sciences; earth, atmospheric and ocean sciences; mathematics and computer sciences; social sciences; psychology; engineering; and engineering technologies and science technologies.

[2] This figure is somewhat smaller than the number of engineering degrees reported by both the Engineering Workforce Commission (EWC) and the American Society for Engineering Education (ASEE), because of taxonomy differences related to the treatment of computer science.

Exhibit 2: Bachelor's Degrees in STEM Fields by Sex, 1966 to 2004



Source: CPST, derived from National Science Foundation WebCASPAR database. (No data available for 1999.)

these fields rose during the 1990s, declined slightly in the early 2000s, but reversed course once again and began to rise in 2003, reaching 80,933 in 2004. During this time period, the number of bachelor's degrees earned by women in these fields increased six times as fast as the number of degrees earned by men. In 1966, women earned one of every four bachelor's degrees in the biological and agricultural sciences; by 2004, they earned 60 percent.

The number of bachelor's degrees earned in **mathematics and computer sciences** increased by a factor of 3.5 in the 1966-2004 time frame, from 20,179 to 71,160. Again, the details reveal much. In mathematics, bachelor's degrees dropped from 20,090 in 1966 to 13,755 in 2004, and women's share of degrees increased from one of every three in 1966 to nearly 46 percent in 2004. But the real action was in the computer sciences, where the number of degrees jumped astronomically from 1966, when only 89 bachelor's degrees were awarded, to 2004 when 57,405 were granted. The growth was uneven, with hills and valleys during the 1966-2004 period. While the number of both men and women earning degrees increased steadily until 1986, reaching 27,069 for men and 15,126 for women, the declines, which started in 1987, were much more pronounced for women. The number of men earning bachelor's degrees dropped 35 percent from 1986 to 1995 before starting to move upward again, but the number of women earning bachelor's degrees dropped 55 percent, from 15,126 in 1986 to 6,772 in 1996, before starting to rise again. In 2004, women earned 14,406 bachelor's degrees — still below the peak number of 15,126 in 1986. The drift by women away from computer sciences has been a troubling trend.

Bachelor's degrees in **earth, atmospheric and ocean sciences** more than doubled over nearly 40 years, growing from 1,712 in 1966 to 3,903 in 2004. The number of bachelor's degrees in these fields earned by women increased more than 10-fold, with women earning only nine percent of these degrees in 1966, but 42 percent in 2004.

The **physical sciences** are the only broad STEM field in which the number of bachelor's degrees declined during the 1966 to 2004 period and, as such, demands a closer look. The physical sciences are comprised of chemistry, physics, astronomy and other physical sciences. With the exception of astronomy, the decline is completely attributable to the drop in the number of men obtaining baccalaureates in these fields. In chemistry, the number of men ranged from a high of 9,651 in 1969 to its current low of 4,550, or a decline of over 50 percent. The drop in total baccalaureates in chemistry would have been even more severe had not women moved into the field: the number of women earning degrees rose from 1,801 in 1966 to 4,755 in 2004. Although the number of women earning chemistry degrees fluctuated during the 1966-2004 time period, the overall direction was upward. A similar picture emerges in physics. The number of women earning baccalaureates in physics increased about four-fold — from 224 in 1966 to 908 in 2004 — while the number of men fell from a high of 5,213 in 1969 to a low of 2,638 in 2000, before rising to 3,248 in 2004. Even in the "other physical sciences" category, the number of men earning bachelor's degrees tumbled from a high of 2,055 in 1980 to the current low of 271 in 2004 — a drop of 87 percent. A similar decline occurred for women, but not so precipitously. The number of women earning degrees in this category dropped 52 percent, from a high of 450 in 1980 to the current low of 216 in 2004.

The numbers of **psychology** degrees steadily increased from 16,966 in 1966 to 82,510 in 2004. Women have always had a strong presence in this field and have only cemented that position over the last 40 years. In 1966, women earned 41 percent of the bachelor's degrees in psychology; in 2004, they earned 78 percent.

The number of bachelor's degrees in the **social sciences**[3] has more than doubled over the 1966 to 2004 period, moving from from 64,364 to 137,557, primarily because of the increasing numbers of women who have chosen these fields. In 1966, women earned 22,060 (34 percent) of the 64,364 bachelor's degrees in the social sciences, but by 2004, they earned 74,957 (55 percent) of these degrees. Among specific social science fields, by 2004 women earned more than half of the bachelor's degrees in political science and sociology, but only half as many economics degrees as men — 8,281 compared to 16,652.

Overall, women have outnumbered men at the undergraduate level since 1982, earning 58 percent of all bachelor's degrees in 2004 and 49.2 percent of the STEM baccalaureates. When the social sciences and engineering technologies and science technologies are excluded, women earned only 38.4 percent of the natural sciences and engineering bachelor's degrees. Women earned more than half of all bachelor's degrees in psychology (77.8 percent), biological/agricultural sciences (60.1 percent) and the social sciences (54.5 percent), while men earned a majority of bachelor's degrees in engineering (79.5 percent), computer sciences (74.9 percent), and physical sciences (57.9 percent). Overall, women's bachelor's degree attainment has been increasing in the STEM fields, while the number of men earning bachelor's degrees in the STEM fields has been hovering around the 200,000 mark for more than 30 years (1970-2000). Some upward movement in men's participation in STEM fields has been visible between 2001 and 2004, but it is not yet certain that this will be sustained; similar small rises and declines can be observed in the data for men's STEM baccalaurate degrees since the mid-1970's, as shown in Exhibit 2 on page 3.

Racial, ethnic and citizenship differences

Over the past 25+ years, the racial/ethnic composition of those earning bachelor's degrees has changed, due to population shifts and increasing college attendance by members of URM groups. However, despite these changes, there continues to be a wide gap in educational attainment between URMs and whites and Asians. In 2003, 17.2 percent of African Americans and 10.0 percent of Hispanics aged 25 to 29 had completed at least a bachelor's degree in any field, compared to 61.6 percent of Asians and 34.2 percent of non-Hispanic whites. These differences in completion rates at the bachelor's level result from differences in high school completion rates, college enrollment rates, and college persistence and attainment rates. In general, African Americans and Hispanics are less likely than whites and Asians to graduate from high school, to enroll in college, and to graduate from college in all fields as well as in the STEM fields.[4] However, URMs are nearly as likely to enter STEM fields as they are other fields. In 2004, URMs earned 16.5 percent of all STEM degrees, compared to 16.9 percent of all degrees.

Appendix Exhibit A3 provides data for STEM degrees awarded to U.S. citizens and permanent residents by race/ethnicity for selected years within the three degree levels.[5] More comprehensive data on degree completions are available in the data archives for the STEM Workforce Data Project at http://www.cpst.org. Looking only at the STEM fields, the proportion of degrees awarded to URMs increased from 9.0 percent in 1977 to 16.5 percent in 2004, while the proportion of degrees awarded to Asians increased from 1.8 to 8.9 percent. Conversely, the proportion of STEM bachelor's degrees earned by non-Hispanic whites declined from 86.7 to 65.2 percent between 1977 and 2004.[6] About one-third of all bachelor's degrees earned by members of every racial/ethnic group, except Asian/Pacific Islanders, were in the STEM fields. As a group, Asian/Pacific Islanders earned almost half of their bachelor's degrees in STEM fields. In 2004, between 9.0 and 13.0 percent of all baccalaureate recipients in each of these racial/ethnic groups (again, except Asian/Pacific Islanders) earned their degrees in the social sciences, 4.0 percent in the biological sciences, 3.0 to 4.0 percent in engineering, and 3.0 to 5.0 percent in computer sciences. Asian/Pacific Islander baccalaureate recipients earned three times as many of these degrees in the biological sciences, computer sciences, and engineering as members of the other racial/ethnic groups: 9.0 and 3.0 percent, respectively.

Overall, trends in bachelor's degrees in the STEM fields for most racial/ethnic groups mirror the totals. For all racial/ethnic groups, the number of bachelor's degrees in engineering dropped or flattened out until 2002, but has started increasing again, while degrees in the physical sciences have declined, especially since the mid-1990s. Degrees in biological sciences generally increased through the late 1990s, then dropped, but have started upward again in recent years. Degrees in computer sciences fell from 1986 through the early 1990s but increased steeply from 1998 through 2004. All racial/ethnic groups generally showed an increase in total STEM bachelor's degrees and in social/behavioral sciences bachelor's degrees.

Students in the United States on temporary visas are more visible at the graduate level, particularly the doctoral level, but also earned a small share (4.1 percent) of

[3] The social sciences include anthropology, area and ethnic studies, economics, history of science, linguistics, political science and public administration, sociology, and "other" social sciences.

[4] National Center for Education Statistics (NCES). 2005. *The Condition of Education 2005,* NCES 2005-094. Washington, DC.

[5] Percentages in Exhibit A3 do not total 100 percent, because data for temporary residents, those for whom either citizenship or race/ethnicity were unknown, and those reporting multiple races are not shown.

[6] In addition, in 2004, non-U.S. citizens earned 4.1% of STEM bachelor's degrees, and those whose race/ethnicity was unknown or who were members of other racial/ethnic groups earned 5.3% in 2004.

STEM bachelor's degrees in 2004. There were important differences across fields in the shares of degrees for students on temporary visas. For example, students on temporary visas earned 7.0 percent of bachelor's degrees in engineering and 8.5 percent of those in computer science. The number of STEM bachelor's degrees awarded to students on temporary visas increased over the past 25 years, reaching 19,114 in 2004, up from 8,297 (2.5 percent) in 1977. Trends in the number of degrees by field generally followed the pattern noted above for all racial/ethnic groups other than Asians.

Where STEM bachelor's graduates get their degrees

Large public institutions were the top producers of STEM bachelor's graduates in 2004. Overall, the University of California at Los Angeles, followed by the University of California at Berkeley and the University of Washington at Seattle, produced the most STEM baccalaureates in 2004. However, the top producing institutions varied greatly by field. In engineering, the Georgia Institute of Technology tops the list, followed by North Carolina State University at Raleigh. In the physical sciences, the University of Washington at Seattle produced the most bachelor's degrees, followed by North Carolina State University at Raleigh. In the geosciences, the U.S. Naval Academy was the top producer, followed by Pennsylvania State University. However, the computer sciences, which include information technology, are completely different, with proprietary for-profit institutions producing the most baccalaureate degrees. The top producer of computer science bachelor's degrees in 2004 was the University of Phoenix, followed by the American College in Atlanta[7] and DeVry Institute of Technology's campus in Oakbrook Terrace, Illinois.

Both men and women tend to get their STEM degrees at major research institutions. In 2004, the top two institutions awarding STEM degrees to men were the University of Texas at Austin, followed by the University of California at Los Angeles; for women, it was the University of California at Los Angeles and the University of California at Berkeley.

Where do minorities earn their undergraduate STEM degrees? U.S. Historically Black Colleges and Universities (HBCUs) continue to play an important role in educating African Americans in STEM disciplines, although that role has been declining since the 1970s. The percentage of African Americans who earned their STEM bachelor's degrees at HCBUs in 2004 was 23.2 percent, down more than seven percentage points from 30.3 percent in 1995. However, of the top 10 institutions awarding STEM baccalaureates to African Americans, seven were HBCUs, including the top three: Florida A&M University, Spelman College, and Howard University.

Hispanics are most likely to attend colleges and universities in regions of the country where the Hispanic population is most concentrated: the Southwest, California, and Puerto Rico. The percentage of STEM bachelor's degrees conferred by institutions in Puerto Rico has been declining. In 1995, 16.6 percent of the bachelor's degrees received by Hispanics in STEM fields were awarded by institutions in Puerto Rico, but by 2004, these institutions accounted for only 12.6 percent of STEM bachelor's degrees to Hispanics. The top two institutions awarding Hispanic baccalaureates in STEM fields were the University of Puerto Rico at Mayaguez and the University of Puerto Rico at Rio Piedras.

American Indians, like Hispanics, also attend colleges and universities where their population is concentrated: California, Oklahoma and Colorado. The top two institutions awarding STEM degrees to American Indians were Oklahoma State University and DeVry Institute of Technology's campus at City of Industry, California.

Asians and non-Hispanic whites are more likely to get their baccalaureate degrees in STEM fields at research institutions. The top three institutions awarding baccalaureates in STEM fields to Asians were three of the University of California's ten campuses: Irvine, Los Angeles, and Berkeley. For non-Hispanic whites, the top three institutions awarding bachelor's degrees in STEM fields in 2004 were Texas A&M University, Pennsylvania State University, and the University of Wisconsin at Madison.

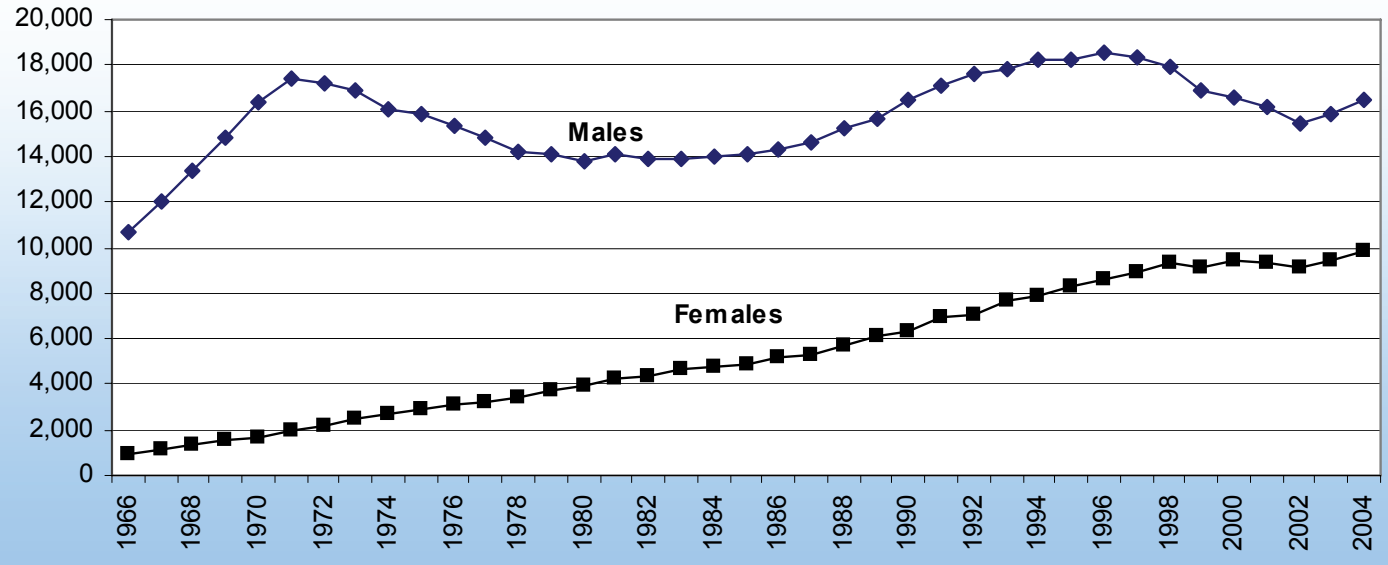
How does the United States compare to other nations in baccalaureate production?

It is difficult to compare degree awards globally, due to definitional differences that result in imprecise categorical aggregations. Historically, the United States has been an overall world leader in providing broad access to higher education. The ratio of bachelor's degrees earned in the U.S. to the population of the college-age cohort remained relatively high at 33.9 per 100 in 2002. However, a number of other countries, mainly in Europe, are gaining ground on the United States in providing a college education to approximately one-third or more of their college-age populations, including Costa Rica, Denmark, France, Finland, Iceland, Portugal, the Netherlands, Sweden, the United Kingdom, Bulgaria, Latvia, Lithuania, Mongolia, Australia, New Zealand, and Taiwan.[8] In several countries around the world, the proportion of first degrees in STEM fields is higher than in the United States. For example, as a proportion of all first degrees, STEM degrees are quite high in three Asian nations: Japan (64 percent), China (57 percent), and South Korea (47 percent), with high proportions of engineering degrees accounting for these figures.

[7] Now the American InterContinental University, part of the Career Education Corporation.

[8] National Science Foundation, *Science and Engineering Indicators, 2006.*

Exhibit 3: Doctorates in STEM Fields by Sex, 1966 to 2004



Source: CPST, derived from National Science Foundation WebCASPAR database.

MASTER'S DEGREES

Annual production of master's degrees boomed during the four decades covered by this report, nearly quadrupling from 140,772 in 1966 to 555,537 in 2004. Growth was less strong for master's degrees in the STEM fields, which grew from 41,093 to 119,880 during the same period. The growth rate in master's degrees in such fields as business administration was much higher. For example, from 1971 to 2004, the annual numbers of new MBA degrees grew by a factor of 8.5 — from 16,490 to 139,347. Consequently, the share of all master's degrees claimed by the STEM fields has been declining. In 1966, 29.2 percent of all master's degrees awarded were in the STEM fields; by 2004, only slightly more than one out of every five (21.6 percent) master's degrees awarded were in STEM fields.

Women's proportion of STEM master's degrees more than tripled from 13.3 percent (5,471) in 1966 to 43.5 percent (52,126) in 2004. In the aggregate, women earned 59.1 percent of all master's degrees awarded in 2004. As was true at the bachelor's level, women earned a majority of STEM master's degrees in psychology (78.1 percent), the biological/agricultural sciences (56.8 percent), and the social sciences (55.9 percent). Men earned three of every four master's degrees in engineering (78.9 percent) and physics (74.8 percent) and a majority in computer science (68.8 percent), mathematics (54.6 percent) and chemistry (53.8 percent).

Citizenship status played a large role in STEM degree awards at the master's level. In 2004, U.S. citizens and permanent residents earned 70.2 percent (84,176) of the master's degrees in STEM fields, down from 87.8 percent in 1977. The number of STEM master's degrees awarded to U.S. citizens and permanent residents moved slowly during the 1980s and early 1990s, but has started growing more rapidly, with significant increases in 2003 and 2004. Again, there were large differences by discipline in the shares of master's degrees. For example, temporary residents have been approaching parity with U.S. citizens in master's degree attainment in engineering (46.1 percent) and computer science (44.4 percent), but are barely visible in psychology (4.0 percent).

The numbers of STEM master's degrees awarded to all U.S. citizen and permanent resident racial/ethnic groups increased in the 1990s. The share of master's degrees earned by URMs increased from 5.9 percent (3,794) in 1977 to 11.1 percent (13,257) in 2004. During the same period, Asians nearly tripled their proportion of STEM master's degrees, going from 2.7 percent (1,749) to 7.2 percent (8,641). However, the proportion of non-Hispanic whites who earned STEM master's degrees dropped dramatically in those years, from 79.0 percent (50,420) in 1977 to 45.9 percent (55,062) in 2004.

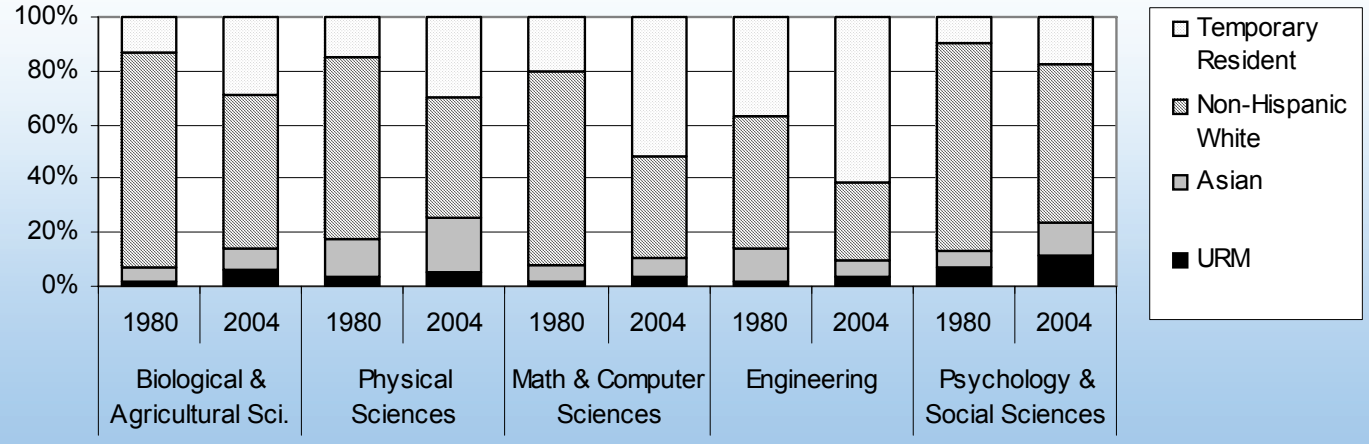
The differences between women and men in choices of STEM disciplines that were noted above for the bachelor's level are repeated at the master's level. In addition, underrepresented minorities were more likely to earn master's degrees in the social sciences (7,844), compared to other STEM areas (5,219 in natural sciences and engineering).

DOCTORATE DEGREES

Much has changed in doctoral education since the first three doctorates in the fields of philosophy and languages, classics, and physics were awarded in the United States by Yale University in 1861.[9] Not only have total numbers

[9] National Science Foundation, *U.S. Doctorates in the 20th Century*, Special Report, June 2006.

Exhibit 4: Percent Doctoral Degrees in STEM Fields by Race/Ethnicity and Citizenship Status, 1980 and 2004



URM (underrepresented minority) includes African American, American Indians, and Hispanics (and Hawaiian and Other Pacific Islanders in 2004). Source: CPST, derived from the National Science Foundation WebCASPAR database.

increased dramatically, but the number of fields has grown, the number of institutions awarding degrees has increased, and the demographic characteristics of degree earners have changed. This report only examines research doctorates awarded during the period 1966 to 2004.

The number of doctorates awarded in all fields has risen by a factor of 2.3, from 17,949 in 1966 to 42,155 in 2004. A similar growth pattern is evident for doctorates in the STEM fields, increasing from 11,570 to 26,275. An all-time high of 27,278 STEM doctoral degrees was reached in 1998. Non-STEM doctoral degrees (primarily education and the humanities) peaked the same year at 15,880. In contrast to the bachelor's and master's degree levels, STEM fields dominate degrees at the doctoral level, representing more than six out of every ten awards. In the 1966-2004 period, the proportion of STEM doctorates has never fallen below the 1976 low of 56.1 percent of all research Ph.D. awards.

Exhibit 3 on the previous page shows that the number of doctorates earned by men fluctuated between 1966 and 2004. The number increased rapidly from 10,646 in 1966 to 17,385 in 1971 and then started downward, reaching 13,814 in 1980. From 1980 through 1996, the number increased, reaching its highest point of 18,454 in 1996 before dropping again. During the past two years — 2003 and 2004 — the number of doctorates earned by men has again been on the upswing, but it is too soon to tell whether this will be a new trend. Overall, the number of doctorates earned by men in the STEM fields grew about 54 percent — from 10,646 in 1966 to 16,405 in 2004. This growth rate was higher than the 45 percent rate for all doctorates earned by men (from 15,863 to 22,976). In contrast, the number of doctorates earned by women was on an upward path for more than 30 years before leveling off in the late 1990s. During this time period, the total number of doctorates awarded to women in all fields increased about nine fold — from 2,086 to 19,098. Because of this tremendous growth, women nearly reached overall gender parity for possession of doctoral degrees, increasing from 11.6 to 45.4 percent of all these awards between 1966 and 2004. A comparable increase occurred with respect to the number of doctorates earned by women in the STEM fields. The increase from 924 in 1966 to 9,819 in 2004 represented a more than ten-fold gain, and women's share of doctoral degrees in the STEM fields rose from 8.0 percent in 1966 to 37.4 percent in 2004.

But again, "the devil is in the details," and the details at the doctorate level are primarily those of citizenship status, portrayed in Exhibit 4, above. Looking only at the STEM fields, in 1966, 83.5 percent of all STEM doctorates were awarded to U.S. citizens and permanent residents. By 2004, this percentage had dropped dramatically to 59.8 percent (15,721 out of a total of 26,275). As discussed below, in some STEM fields the percentage is much lower.

Differences by Discipline, Citizenship, Gender and Race/Ethnicity

The largest STEM field at the doctoral level is the **biological and agricultural sciences.** The number of doctorates awarded in this field grew by 158 percent, from 2,711 in 1966 to 6,983 in 2004. However, the growth rate differed by citizenship. Temporary residents earned doctoral degrees in the biological and agricultural sciences (from 491 to 1,875) at a growth rate three times as fast as the growth rate for U.S. citizens and permanent residents (from 2,182 to 4,750). Because of this differential in growth rates, the proportion of doctorates in the biological and agricultural sciences that were earned by U.S. citizens and permanent residents declined from 80.4 percent in 1966 to 68.0 percent in 2004. Looking only at U.S. citizens and permanent residents, the

number of women earning doctorates in the biological and agricultural sciences increased 808 percent, from 275 in 1966 to 2,223 in 2004. This compares with an increase of only 32 percent for men, from 1,907 in 1966 to 2,525 in 2004. Because of this wide variation in growth rates, women are nearing parity in the biological and agricultural sciences, earning 45.0 percent of the total doctorates awarded in 2004. Among all doctoral degrees in the biological and agricultural sciences, the share of awards to URMs nearly tripled, rising from 2.1 percent (90 degrees) in 1977 to 5.9 percent (415) in 2004. URMs' share of biological and agricultural sciences doctoral degrees, as a percentage of those awarded to U.S. citizens and permanent residents, also increased moderately over this same period, from 2.5 to 8.7 percent between 1977 and 2004.

In the **physical sciences,** the number of doctorates awarded in 2004 (3,353) was still well below the peak of 3,977 reached in 1994. The share of doctorates earned by U.S. citizens and permanent residents in the physical sciences has been dropping and is nearing parity with that of temporary residents. In 1966, U.S. citizens and permanent residents earned 85.5 percent of the doctorates in the physical sciences; by 2004, they earned only 55.7 percent. This decline would have been much more severe if women U.S. citizens and permanent residents had not increased their proportion of doctorates in the physical sciences from 3.7 percent (85 degrees) in 1966 to 27.3 percent (510) in 2004. The number of doctorates earned by male U.S. citizens and permanent residents declined 38 percent from 2,185 in 1966 to 1,356 in 2004.

Among the subfields included in the physical sciences, the biggest drop was in physics, where the number of men earning doctorates plummeted nearly two-thirds, from a high of 1,360 in 1971 to only 473 in 2004. However, with recent physics enrollments on the upswing, these declines may be halted. It also should be noted that the number of doctorates in physics also declined among temporary residents, with significant declines in awards to persons from China, India, Korea, and Taiwan. The quality and capacity of local institutions for advanced graduate education in these countries has been rising, a factor that may be contributing to this trend. A similar decline occurred in chemistry, where the number of doctorates earned by men dropped nearly 58 percent from a high of 1,882 in 1970 to a low point of 798 in 2004. In addition, the overall proportion of doctoral degrees awarded to URMs in the physical sciences increased from 3.8 percent (105 degrees) in 1977 to 5.9 percent (197) in 2004.

Engineering shows a similar picture. While the total number of U.S. citizens and permanent residents earning doctorates increased from 1,834 to 2,182 from 1966 to 2004, that increase was completely accounted for by the influx of women. The number of U.S. citizen and permanent resident men earning doctoral degrees in engineering declined from 1,829 in 1966 to 1,712 in 2004, far off the high of 2,863 reached in 1996. In contrast, the number of temporary residents earning doctorates in engineering increased from 387 (16.8 percent) in 1966 to 3,302 (57.2 percent) in 2004. As was the case in the physical sciences, the proportion of engineering doctoral degrees awarded to URMs increased from a mere 29 degrees in 1977 (1.1 percent of those awarded to U.S. citizens and permanent residents) to 189 in 2004. Doctoral awards to URMs in engineering accounted for only 1.5 percent of all such awards in 1973 but increased to 3.3 percent in 2004. The number of Asian/Pacific Islanders among those receiving doctoral degrees in engineering increased, but the group's share of doctoral degrees declined. In 1977, Asian/Pacific Islanders earned 247 (9.3 percent) doctoral degrees in engineering; in 2004 there was a moderate increase to 355 of these degrees to members of this group, but their share of the total declined to 6.1 percent. In contrast, the proportion of doctorates earned by non-Hispanic whites declined from its high point of 78.8 percent in 1977 to 63.5 percent (1,719) in 2004.

About the STEM Workforce Data Project

The purpose of the STEM Workforce Data Project is to identify and distribute reliable statistics on scientific, technological, engineering and mathematical workers in the United States. Like the similar IT Workforce Data Project (see http://www.cpst.org for those reports), the STEM project uses the full range of statistical resources offered by U.S federal agencies as well as other private sources of information. Our reports have drawn upon previously unused data, maintained by the Bureau of Labor Statistics, from Current Population Surveys, but other sources of information are also being examined and applied.

This is a project of the Commission on Professionals in Science and Technology (CPST) in Washington, D.C., supported by grants from the Alfred P. Sloan Foundation. Queries about the project are welcome. The principal investigators are Eleanor Babco, who recently retired as CPST's executive director (202-326-7080; babco@cpst.org), and Richard Ellis of Ellis Research Services in Carlisle, PA (717-218-9818; raellis@earthlink.net). Nathan Bell, CPST's associate director, is the project's manager (nbell@cpst.org). Dr. B. Lindsay Lowell of the Center for the Study of International Migration at Georgetown University is contributing expertise on foreign content in the U.S. STEM workforce. Dr. Ronil Hira of the Rochester Institute of Technology will comment on the policy implications of STEM workforce trends. Robert K. Weatherall, the retired past director of the Office of Career Services at MIT, is participating in the project as a reviewer of draft reports, as is CPST's new executive director, Dr. Lisa Frehill (lfrehill@cpst.org).

—EB/LF, September 11, 2006

The number of doctorates awarded in **mathematics and computer sciences** increased from 769 in 1966 to 2,024 in 2004. Most of this growth is attributable to increased numbers of degrees awarded to temporary residents. In 1966, 85.3 percent of these degrees were earned by U.S. citizens and permanent residents; by 2004, less than half — 47.3 percent — were. Among U.S. citizens and permanent residents, the number of doctoral degrees earned by women, URMs, and Asian/Pacific Islanders all increased. The growth was most pronounced for women, with an increase from 5.5 percent (36) in 1966 to 26.7 percent (256) in 2004. URMs' proportion of doctorates in mathematics and computer science also increased, from just 11 (1.1 percent of those awarded to U.S. citizens and permanent residents) in 1973 to 68 in 2004, while that for Asian/Pacific Islanders increased from 53 in 1973 to 127 in 2004. However, non-Hispanic whites still earned the majority of mathematics and computer science doctorates awarded to U.S. citizens and permanent residents (719, or three out of every four) in 2004. Looking only at computer science doctorates, the number of these degrees earned by U.S. citizens and permanent residents grew steadily from 1977 (26 degrees) through 1995 (616). From 1996 through 2002, the number of doctorates in computer science earned by U.S. citizens and permanent residents declined, but in 2003 this trend reversed course and started upward again.

In the **geosciences**, the number of doctorates awarded to U.S. citizens and permanent residents increased from 344 in 1966 to 426 in 2004. However, the number earned by temporary residents increased at a faster pace, so that by 2004 U.S. citizens and permanent residents earned just 63.4 percent of the doctorates in these fields, down from 85.1 percent in 1966. Again, this decline would have been even more severe without the entry of women. Among U.S. citizens and permanent residents, the number of women earning doctorates in the geosciences increased from 10 in 1966 to 166 in 2004, while the number of doctorates earned by men actually decreased from 334 in 1966 to 260 in 2004.

Trends over time were similar for the **social sciences and psychology.** U.S. citizens and permanent residents still earned a majority of all doctorates awarded in 2004. While temporary residents have not been highly represented in psychology, earning just 5.6 percent of those doctoral degrees in 2004, the trend in the social sciences since 1966 mirrors that in the natural sciences and engineering: temporary residents' share of social science doctoral degrees increased from 15.5 to 29.1 percent between 1966 and 2004. Among U.S. citizens and permanent residents, women have nearly achieved parity in social science doctorate attainment, earning 48.1 percent of those awards in 2004. URMs are also more visible in the social sciences, earning 531 or 12.8 percent of the 4,131 doctorates awarded to U.S. citizens and permanent residents in 2004. Asian representation[10] among doctoral degrees awarded to U.S. citizens and permanent residents in the social sciences and psychology also increased, from 4.2 to 12.7 percent between 1977 and 2004.

SUMMARY AND CONCLUSIONS

While the number of bachelor's degrees in all fields continued to grow, STEM bachelor's degrees as a proportion of all U.S. bachelor's degrees held steady at about one-third from 1966 to 2004. At the master's level, while the number of both total degrees and STEM degrees continued to increase, STEM degrees as a proportion of all degrees at the master's level declined from 29.2 percent in 1966 to 21.6 percent in 2004. At the doctoral level, STEM degrees continue to dominate, but the real story here is the decreasing participation rate of U.S. citizens and permanent residents in STEM doctoral attainment. Although the overall number of doctoral degrees earned by U.S. citizens and permanent residents increased from 9,657 in 1966 to 15,721 in 2004, the proportion of STEM doctoral degrees earned by U.S. citizens and permanent residents dropped from 84 percent in 1966 to about 60 percent in 2004.

While the United States continues to be a world leader in STEM higher education, many other countries are now increasing their capacity for higher education and many attract large numbers of non-U.S. students to their institutions. Global competition for the best and brightest students, combined with increased security concerns in the U.S. post-9/11 economy, especially in the defense sector, imply a need for more U.S. citizens to be encouraged to pursue degrees in the STEM fields. In order to remain competitive in the global economy, the U.S. needs to make significant efforts to increase the number of its own citizens who pursue careers in science and engineering. We cannot afford to rest on our laurels of past educational dominance or on our ability to attract the "best and the brightest" from the rest of the world.

[10] Up until 2000 (inclusive), "Asians" includes "Asian and Pacific Islanders." Starting in 2001 the U.S. Census Bureau separated "Native Hawaiians and Other Pacific Islanders" out from the "Asian" category. Given the history of the Pacific Islands, including Hawaii, members of these groups are now often counted by diversity advocates as "Underrepresented minorities," but tend to represent a small number within that category (e.g., in 2004 there were a total of 87 doctoral degrees in all fields awarded to members of this group).

Appendix: Tabular Exhibits and Notes on the Data

Appended exhibits on this and the following pages, and source spreadsheets available in the data archives for the STEM Workforce Data Project at http://www.cpst.org, provide further details on STEM degrees.

This report utilizes degree data from 1966 to 2004 obtained from WebCASPAR, a database system of the National Science Foundation. The bachelor's and master's degree data in WebCASPAR were obtained from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) Completions Survey, which is conducted annually by the National Center for Education Statistics (NCES). This survey collects data on all degrees conferred from the universe of accredited institutions of higher education. Data on doctorates are from the *Survey of Earned Doctorates*, a universe survey of individual doctorate recipients sponsored by the National Science Foundation (NSF) and five other federal agencies. Professional degrees are not included, nor are any data on associate degrees. For both surveys, data cover earned degrees conferred in the aggregate United States, which

Exhibit A-1. Total Number of Bachelor's, Master's, and Doctoral Degrees Awarded, by Broad STEM Fields, Selected Years, 1966-2004

	1966	1970	1980	1990	2000	2004
Bachelor's degrees:						
Biological and agricultural sciences	29,804	44,447	63,942	45,451	83,148	80,933
Physical sciences	17,174	21,524	23,625	16,201	18,627	18,143
Mathematics and computer sciences	20,179	29,109	22,686	42,369	49,123	71,160
Engineering	35,826	44,770	58,810	64,705	59,536	64,675
Subtotal: natural sciences and engineering	102,983	139,850	169,063	168,726	210,434	234,911
Engineering and science technologies	2,357	5,228	12,387	19,437	15,531	15,330
Psychology	16,966	33,784	42,513	54,018	74,654	82,510
Social sciences	64,364	110,596	93,119	105,350	113,534	137,557
Total: all STEM bachelor's degrees	186,670	289,458	317,082	347,531	414,153	470,308
Total: all bachelor's degrees awarded	524,008	798,070	940,251	1,062,151	1,253,121	1,407,009
STEM as a percent of all bachelor's degrees	35.6%	36.3%	33.7%	32.7%	33.0%	33.4%
Master's degrees:						
Biological and agricultural sciences	5,865	7,619	9,631	7,527	10,183	11,777
Physical sciences	4,965	5,920	5,201	5,401	4,857	5,600
Mathematics and computer sciences	5,010	7,107	6,515	13,327	17,824	24,150
Engineering	13,705	15,597	15,943	23,995	25,736	33,872
Subtotal: natural sciences and engineering	29,545	36,243	37,290	50,250	58,600	75,399
Engineering and science technologies	44	158	526	1,251	1,368	1,501
Psychology	2,423	3,962	7,861	9,308	13,708	15,298
Social sciences	9,081	13,490	18,938	18,230	23,375	27,682
Total: all STEM master's degrees	41,093	53,853	64,615	79,039	97,051	119,880
Total: all master's degree's awarded	140,772	209,387	299,095	324,947	456,260	555,537
STEM as a percent of all master's degrees	29.2%	25.7%	21.6%	24.3%	21.3%	21.6%
Doctoral degrees:						
Biological and agricultural sciences	2,711	4,165	4,755	5,552	6,892	6,983
Physical sciences	3,059	4,391	3,109	4,212	4,113	4,025
Mathematics and computer sciences	769	1,225	962	1,597	1,909	2,024
Engineering	2,301	3,446	2,479	4,894	5,321	5,776
Subtotal: natural sciences and engineering	8,840	13,227	11,305	16,255	18,235	18,808
Psychology	1,139	1,890	3,098	3,282	3,618	3,336
Social sciences	1,591	2,935	3,372	3,332	4,156	4,131
Total: all STEM doctoral degrees	11,570	18,052	17,775	22,869	26,009	26,275
Total: all doctoral degrees awarded	17,949	29,498	31,020	36,068	41,365	42,155
STEM as a percent of all doctoral degrees	64.5%	61.2%	57.3%	63.4%	62.9%	62.3%

includes the 50 states, the District of Columbia, and the U.S. territories and outlying areas (American Samoa, the former Canal Zone, the Northern Mariana Islands, Puerto Rico, the U.S. Virgin Islands, and the Trust Territory of the Pacific Islands). Degree data are reported for academic years, from July of one year through June of the following year.

Establishing and maintaining a completely consistent series of degree data over a period of time is difficult. Definitions, instructions, and field classifications change, and new disciplines emerge. By using WebCASPAR, the data are presented as consistently as possible, using taxonomies from the *Classification of Instruction Programs*, as well as appropriate reclassifications according to NSF field categories. NSF data for science and engineering fields do not include engineering technology and science technology degrees, but they are included in totals presented in this report (except at the doctorate level, where no engineering technology or science technology fields were reported).While degree data have been collected by detailed field and sex since the beginning of the 20th century by the Office of Education, the predecessor of the U.S. Department of Education, racial/ethnic data were not collected

Exhibit A-2. Percent of Bachelor's, Master's, and Doctoral Degrees Awarded to Females, by Broad STEM Fields, Selected Years, 1966-2004

	1966	1970	1980	1990	2000	2004
Bachelors degrees:						
Biological and agricultural sciences	25.0%	24.1%	39.1%	48.2%	55.8%	60.1%
Physical sciences	13.6	13.8	23.9	31.4	40.8	42.2
Mathematics and computer sciences	33.2	36.1	36.4	35.8	32.7	29.1
Engineering	4.0	8.0	10.1	15.4	20.5	20.5
Subtotal: natural sciences and engineering	16.2	17.5	26.5	31.0	39.1	38.4
Engineering and science technologies	1.0	1.0	10.3	10.8	13.4	14.4
Psychology	40.8	43.6	63.3	71.5	76.5	77.8
Social sciences	34.3	36.6	44.8	46.3	54.2	54.5
Total: all STEM bachelors degrees	24.5	27.6	36.2	40.9	49.0	49.2
Total number: all bachelors degrees awarded	222,971	344,465	462,501	566,284	716,963	810,817
STEM as a percent of all bachelor's degrees	20.5	23.2	24.8	25.1	28.3	28.6
Masters degrees:						
Biological and agricultural sciences	20.8	25.8	32.5	45.8	52.3	56.8
Physical sciences	10.6	14.3	18.7	26.5	35.6	39.5
Mathematics and computer sciences	20.3	25.5	27.6	31.1	35.7	33.7
Engineering	0.6	1.1	7.0	13.6	20.7	21.1
Subtotal: natural sciences and engineering	9.6	13.2	18.8	24.5	32.0	32.1
Engineering and science technologies	4.5	4.4	16.5	26.0	30.4	34.0
Psychology	32.9	37.3	56.8	67.5	75.1	78.1
Social sciences	20.2	25.6	34.8	43.8	53.1	55.9
Total: all STEM masters degrees	13.3	18.1	28.2	34.1	43.3	43.6
Total number: all master's degrees awarded	47,588	83,241	147,936	170,922	265,026	328,202
STEM as a percent of all master's degrees	11.5	11.7	12.3	15.8	15.9	15.9
Doctoral degrees:						
Biological and agricultural sciences	12.0	12.9	24.3	33.7	42.6	45.0
Physical sciences	4.5	5.8	12.8	18.8	24.5	25.9
Mathematics and computer sciences	6.1	6.3	12.1	16.8	21.0	24.7
Engineering	0.3	0.5	3.6	8.5	15.7	17.6
Subtotal: natural sciences and engineering	6.0	6.7	13.5	20.6	28.6	30.5
Psychology	21.5	23.5	42.3	58.3	66.6	67.3
Social sciences	10.5	11.3	26.9	33.3	42.9	44.0
Total: all STEM doctoral degrees	8.1	9.3	22.7	28.2	36.3	37.4
Total number: all doctoral degrees awarded	2,086	3,971	9,408	13,107	18,125	19,098
STEM as a percent of all doctoral degrees	44.9	42.3	42.9	49.2	52.1	51.5

until 1973 at the doctoral level and 1977 at the bachelor's and master's degree levels. And, until 1995 racial/ethnic data were collected only by broad fields. Some fields are now included with the STEM professions which NSF has not included in its tabulations in the past. An example is the field of history, which the U.S. Department of Education does include in its degree statistics for the broad field of "social sciences," where it accounted for 20 to 23 percent of those bachelor's and master's degrees.

Exhibit A3. Percent of STEM Degrees Awarded to U.S. Citizens and Permanent Residents, by Race/Ethnicity within Degree Level, Selected Years, 1977-2004

	1977			1990			2000			2004		
	URM	Asian	Non-Hispanic White	URM	Asian	Non-Hispanic White	URM	Asian	Non-Hispanic White	URM	Asian	Non-Hispanic White
Bachelors degrees:												
Natural science and engineering	6.3%	2.3%	91.3%	9.5%	8.9%	81.6%	14.9%	12.8%	72.2%	16.1%	13.1%	70.8%
Engineering and science technologies	N/A	N/A	N/A	11.5	4.1	84.4	18.8	5.2	76.0	20.9	4.5	74.6
Psychology and social science	12.0	1.5	86.5	10.9	3.7	85.5	20.2	7.0	72.8	20.8	7.6	71.6
Total STEM	10.0	1.8	88.2	10.4	5.7	83.9	18.2	9.1	72.7	19.0	9.6	71.4
Total, all bachelor's degrees	9.8	1.5	88.7	10.7	3.8	85.5	17.2	6.4	76.4	18.5	6.7	74.8
STEM as a percent of all bachelor's degrees	28.7	33.4	27.8	28.7	44.2	29.1	27.6	37.0	24.8	28.0	39.1	26.0
Masters degrees:												
Natural science and engineering	4.5	4.0	91.5	5.5	10.3	84.2	10.2	15.3	74.5	12.5	16.0	71.5
Engineering and science technologies	N/A	N/A	N/A	5.8	8.2	86.0	14.8	4.8	80.5	18.4	7.7	74.0
Psychology and social science	14.7	8.5	76.8	9.6	3.1	87.3	19.6	4.8	75.6	23.0	5.4	71.5
Total STEM	9.0	6.0	85.0	6.9	7.8	85.3	14.5	10.4	75.1	17.2	11.2	71.5
Total number, all master's degrees	9.7	1.7	88.6	8.9	3.7	87.4	15.0	5.7	79.3	17.8	6.3	75.9
STEM as a percent of all master's degrees	18.4	69.3	18.9	15.3	41.4	19.1	17.4	32.9	17.1	17.3	32.0	16.8
Doctoral degrees:												
Natural science and engineering	3.0	9.9	87.1	4.2	16.4	79.4	6.9	18.9	74.2	8.2	19.5	72.3
Psychology and social science	7.5	4.6	88.0	9.6	11.9	78.5	13.2	12.8	74.0	14.1	14.0	71.8
Total STEM	4.9	7.6	87.5	6.2	14.7	79.1	9.3	16.5	74.1	10.5	17.4	72.1
Total number, all doctoral degrees	7.7	6.9	85.4	7.9	18.6	73.5	10.9	20.8	68.2	12.1	23.6	64.3
STEM as a percent of all doctoral degrees	32.0	54.8	51.1	38.3	38.7	52.4	41.3	38.3	52.5	39.8	33.6	51.3

Note: The percentages in this chart do not necessarily sum to 100 percent, because data for temporary residents, those for whom either citizenship or race/ethnicity was unknown, and those who reported "other" or multiple races are not reported.